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DESIGN FOR ENVIRONMENT

A statistical approach to interpret relative environmental performance within product categories

Thomas P. Gloria · Colleen Kohlsaat · Paula Bautil · Brianna Wolf · Desirae Early · Barruch Ben-Zekry

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Abstract
Purpose Levi Strauss & Co. (LS&Co.) has developed a statistical-based interpretation methodology, E-valuate™, with the primary objective of assessing the environmental impact of a product, a subassembly, or process across whole product lines. The nature of apparel manufacturing, with raw materials and manufacturing facilities all across the globe, makes comparisons between individual products inherently difficult. With the multitude of decisions at each manufacturing stage, and localized factors such as grid electricity mixes, a noncontextualized comparison between two products yields little actionable information. By assessing the life cycle impact of products and subassemblies within standardized groups of like products, or cohorts of interest, the E-valuate™ methodology provides directional indication of whether or not the life cycle impacts for a given product demonstrate an improvement, that is, decreased environmental impact or otherwise as compared to the cohort.
Methods Using descriptive statistics of a cohort of products or materials, in this case denim fabrics, performance is determined by percentile rankings. Final scores are expressed as readily understood performance measures of good, better, and best over business-as-usual practices. Thresholds to distinguish good, better, and best scores are based on percentile rankings of performance at the 70th, 80th, and 90th percentiles, respectively.
Results and discussion In this paper we present the assessment of 26 fabrics from raw material production or extraction up to and including the dyeing and weaving of a fabric, demonstrating the ability of the E-valuate™ method to assess life cycle environmental performance of a product or product component relative to a cohort of like products or components.
Conclusions The E-valuate™ method is a first major step in the development of a comprehensive science-based approach to measuring the environmental performance of fabrics and apparel products. The pilot assessment of the 26 fabrics has yielded results that can be used to engage both internal and external stakeholders. The E-valuate™ method can address the needs of three primary stakeholders: (1) relative rankings to support decisions for product designers and developers, (2) substantiation of external claims of environmental performance, and (3) communication of environmental performance to suppliers and contractors.

Keywords Apparel · Design for environment · Environmental claims · Interpretation analysis · Life cycle management · Product categories · Statistics

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Colleen Kohlsaat, Brianna Wolf, and Barruch Ben-Zekry are no longer affiliated with LS&Co.

T. P. Gloria (✉)
Industrial Ecology Consultants, 35 Bracebridge Road, Newton, MA 02459, USA
e-mail: t.gloria@life-cycle.org

C. Kohlsaat · P. Bautil · B. Wolf · D. Early · B. Ben-Zekry
Levi Strauss & Co, 1155 Battery Street, San Francisco, CA 94111, USA

1 Introduction

In 2007 Levi Strauss & Co. (LS&Co.) commissioned life cycle assessment (LCA) studies for internal use of two high-volume products: Levi's® 501® medium stone wash jeans and Dockers® Original Khaki pants (LS&Co. 2007). The studies provided a detailed assessment of the environmental impacts across each stage of the products' life cycle, from cradle to grave. These holistic studies, the first of their kind commissioned by the company, raised the awareness of the potential environmental impacts of products across many business functions of LS&Co.

Although the initial LCA studies provided valuable understanding of the major impacts attributed to each life cycle stage,

they did not provide the necessary insight and robustness to determine which components of the product design and development are relevant for improvement. Evolving the use of LCA information in its current form for product development, design, and sourcing was limited. In order to be valuable in a business context, LS&Co. realized the need for the LCA approach to assess the environmental impact of a product at the assembly level or process under consideration at the speed of seasonal design cycles typical for the apparel industry and at a scale covering whole product lines. The nature of apparel manufacturing, with raw materials and manufacturing facilities around the globe, makes one-to-one comparisons between individual products inherently difficult. With the multitude of decisions at each manufacturing stage and localized factors such as grid electricity mixes, a comparison between two single products yields little insight regarding the true cause of differences observed for products that are manufactured across multiple supply chains that can fluctuate on a seasonal basis. Therefore, E-valuate™ was developed by LS&Co. to assess the significance of differences observed in environmental impact for a multitude of like products based on the many factors of material selection, process technology, and geography.

The first version of E-valuate™ was finalized in 2009 and reviewed by a panel of experts convened by Ceres. This first version was tested on the evaluation of different fibers in selected fabrics using a baseline fabric as a comparison reference point. The scope included raw material production and extraction to weave of fabric; it did not include the dye phase of fabric production. Key comments from the review panel were the following: the scope should include to the extent possible the full life cycle of the product, especially the dyeing and finishing processes; the methodology should be sophisticated yet provide clear indication of performance, such as a three-tiered rating system of good, better, and best; performance thresholds to determine what is "eco" should be based on a rigorous statistical method that demonstrates measures of significant difference, including normalization; and the methodology should be used for the basis of setting product category rules and to the extent possible be aligned with other broader sustainability indexes.

In 2010 the E-valuate™ development team conducted an intense 3-day charrette incorporating the majority of comments from the Ceres stakeholder event, particularly the use of comparing the results of one product to a representative cohort of like products versus relying on a single product as a baseline. This post-Ceres review version of the method was presented as a poster at LCA X conference, Portland, Oregon, USA (Gloria and Kohlsaat 2010). The resulting interpretation method was found to be more robust and less subjective to the idiosyncrasies of a specific baseline product, such as changes in environmental performance due to geographical location of cotton sourcing, production efficiencies, and fabric finishing processes. By utilizing the descriptive statistics of a representative cohort of products, the evaluation of similar products do not shift wildly based on changes in the baseline product.

In addition to the development and application of E-valuate™, LS&Co. also recognizes that a standard method for evaluating jeans and apparel products is necessary for reasons of comparability among products. As such, the development of an applicable product category rule (PCR) is being pursued. LS&Co. is currently engaged in efforts in the apparel industry to create a PCR for textile products under the French national organization for standardization (AFNOR)/French Agency for Environment and Energy Management (ADEME) Grenelle 2 framework for environmental labeling (ADEME/AFNOR 2010). Other related activities include the application of the European Commission's harmonized methodology for product environmental footprint (PEF) (EC 2012) calculation and the metrics-based version of the Sustainable Apparel Coalition's Apparel Index (SAC 2012).

Fig. 1 Apparel production steps

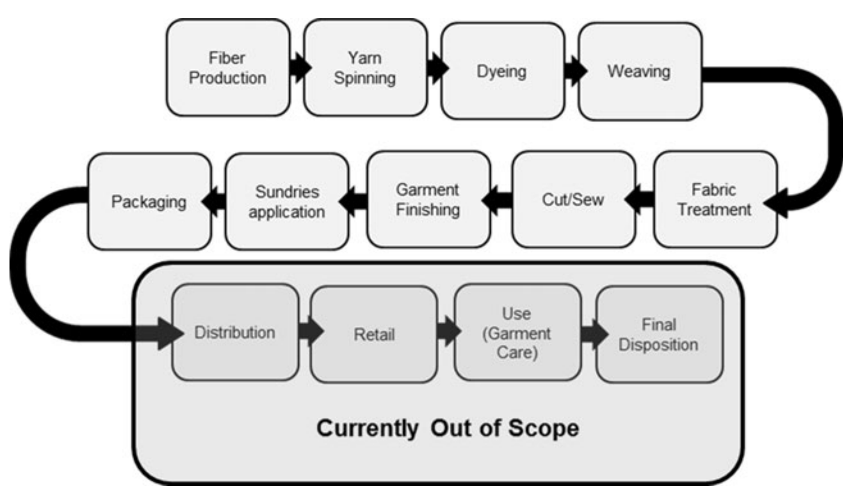

Table 1 E-valuate™ impact categories

E-valuate™ impact categories			
Category	Description	Units	Reference
Climate change	Global warming potential =of GHGs released to the environment.	kg CO_2-e	IPCC (2007), 100 years
Water Intake	Freshwater taken from the environment	m^3	Inventory flow
Water consumption	Net freshwater taken from the environment minus water returned to the same watershed at the same quality or better.	m^3	Net inventory flow
Eutrophication	Eutrophication of freshwater, marine, and terrestrial environments	kg PO_4-e	CML (2002)
Land occupation	Total land occupied to support the product system assessed	m^2-year	ReCiPe (2008)
Abiotic depletion	A measure of the depletion of nonrenewable resources that includes fossil energy, metals, and minerals	kg Sb-e	CML (2002)

2 Methodology

The E-valuate™ methodology has been designed to assess the performance of products and subcomponents of products (e.g., fabrics and sundries) from raw material production through the factory gate. A key aspect of the methodology is to provide readily understood results to non-LCA experts such as designers, material suppliers, and consumers. Statistical methods to assess final impacts allow for final product scores presented in a final ranking as either business as usual, good, better, or best. Although the ranking of business as usual represents a large majority of products, those below the 70th percentile, further delineation to categories of “worst” or “poor” performance was deemed not necessary, as the fundamental intent is to identify and promote more sustainable product design. The E-valuate™ methodology is not intended to address nor assess social or economic considerations; hence, social LCA impact assessment criteria are not included.

2.1 Data requirements and impact methods used

As shown in Fig. 1, the general steps of apparel production include fiber production; yarn spinning; dyeing; weaving; fabric treatment; fabric cutting and garment sewing (cut/sew); garment finishing and application of sundries (additional apparel items such as buttons, zippers, rivets, pockets, tags, and labels), and packaging for distribution and retail display. The life cycle stages of distribution, retail display, garment use, and final disposition are currently not included.

Primary data is collected from textile fabric mills on generic process chemicals consumed, the energy used by fuel type, the water consumed, the material efficiency, and geographical location to enhance estimation of electricity grid impacts and future use to apply geographically specific life cycle impact assessment (LCIA) impacts, such as water scarcity, acidification, eutrophication, and land transformation as they become available. Limited primary data is also collected at the garment production step to estimate marker efficiencies, the amount of fabric cut away from the pattern that does not end up in the garment, and at the finishing step to estimate the energy, water, and chemical inputs for each product’s finish formula. Secondary data, data that has been sampled at selected facilities on garment cutting and sewing processes, sundry material types and quantities, and packaging material types are assembled to best approximate impact during these process steps. Secondary data from the ecoinvent v 2.2 database is used to estimate basic material and production chemical inputs, electricity grid impacts, and fuel consumption impacts.

In its latest version of E-valuate™, LS&Co. uses the following impact categories and methods shown in Table 1. Impact assessment methods are continuously being developed by academicians, and consensus is growing among government agencies and nongovernmental organizations. Therefore, LS&Co. will adapt and adopt methods to the E-valuate™ method that represent industry consensus on the most appropriate impacts to consider.

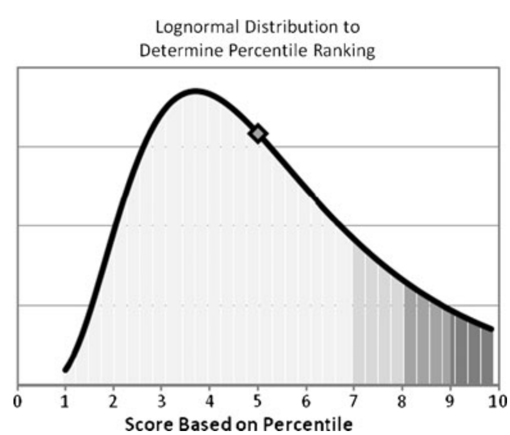

Fig. 2 Lognormal distribution to determine percentile ranking

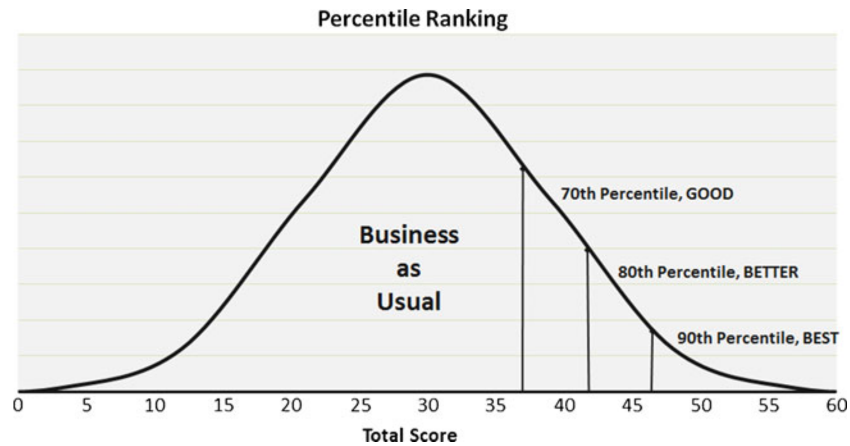

Fig. 3 Total score to determine "eco" ranking

2.2 Scoring, weighting, grouping, and interpretation

The interpretation of the results of an evaluated product or subproduct is based on scoring for each of the six impact categories that are equally weighted, grouped together, and then interpreted based on statistical results within a representative cohort of like products for comparison.

Table 2 LCA results of 26 denim fabrics (per yard^2)

	Fabric weight (oz/yard^2)	Energy use[a] (MJ)	Total fiber loss	GWP (kg CO^2-e)	Water use (m^3)	Water consumption (m^3)	Eutrophication (kg PO_4^{-3} eq)	Land occupation (m^{2}a)	Abiotic depletion (kg Sb-e)
Fabric 1	9.50	130	45 %	6.9	6.17	6.01	0.026	20.3	0.056
Fabric 2	14.00	130	51 %	7.1	6.17	6.01	0.026	20.3	0.056
Fabric 3	12.00	72	10 %	3.1	1.96	1.87	0.022	8.6	0.026
Fabric 4	11.80	81	10 %	3.2	3.33	3.23	0.022	16.2	0.029
Fabric 5	14.00	69	10 %	2.6	2.00	1.91	0.021	9.6	0.024
Fabric 6	12.75	69	10 %	2.6	2.00	1.91	0.021	9.6	0.023
Fabric 7	14.25	71	13 %	2.6	2.01	1.91	0.021	9.6	0.024
Fabric 8	11.25	74	12 %	3.0	2.02	1.91	0.021	9.6	0.025
Fabric 9	11.75	78	12 %	3.7	2.03	1.91	0.022	9.6	0.027
Fabric 10	14.25	106	10 %	5.1	2.06	1.91	0.024	9.7	0.039
Fabric 11	12.50	100	10 %	4.7	2.05	1.91	0.024	9.6	0.037
Fabric 12	12.50	105	12 %	5.1	2.06	1.91	0.024	9.7	0.039
Fabric 13	13.70	148	27 %	6.9	11.03	10.78	0.023	13.6	0.058
Fabric 14	11.50	204	38 %	10.6	1.80	1.61	0.027	10.0	0.086
Fabric 15	13.00	205	39 %	10.6	1.80	1.61	0.027	10.0	0.087
Fabric 16	13.25	212	38 %	11.5	1.83	1.61	0.027	10.0	0.089
Fabric 17	13.75	153	11 %	7.1	11.05	10.78	0.025	13.6	0.060
Fabric 18	14.50	152	27 %	7.2	11.04	10.78	0.025	13.6	0.060
Fabric 19	11.90	155	11 %	7.3	11.06	10.78	0.025	13.6	0.062
Fabric 20	12.00	80	13 %	3.3	2.78	2.65	0.023	11.2	0.029
Fabric 21	14.75	103	13 %	5.2	6.15	6.01	0.024	27.8	0.043
Fabric 22	12.50	113	18 %	4.9	7.46	7.33	0.022	8.6	0.044
Fabric 23	10.00	100	27 %	4.3	5.73	5.62	0.022	8.4	0.038
Fabric 24	10.00	99	24 %	4.4	6.13	6.01	0.023	20.3	0.038
Fabric 25	10.00	98	22 %	4.4	6.04	5.92	0.023	20.0	0.038
Fabric 26	10.76	89	14 %	3.8	1.73	1.61	0.022	9.9	0.032

[a] Energy use as cumulative energy demand (CED)

Table 3 Rank order results of 26 denim fabrics

	Total fabric score[a]	Percentile ranking	Rating	Yarn subscore[a]	Fabric subscore[a]	GWP	Water use	Water consumption	Eutrophication	Land use	Abiotic depletion
Fabric 3	53	90 %	Best	53	31	9	9	9	8	9	9
Fabric 5	53	90 %	Best	52	47	9	9	9	9	8	9
Fabric 6	53	90 %	Best	52	47	9	9	9	9	8	9
Fabric 7	53	90 %	Best	52	45	9	9	9	9	8	9
Fabric 8	53	90 %	Best	52	37	9	9	9	9	8	9
Fabric 9	51	87 %	Better	52	27	8	9	9	8	8	9
Fabric 26	49	84 %	Better	51	23	8	9	9	8	7	8
Fabric 20	45	77 %	Good	46	20	9	8	8	6	6	8
Fabric 11	43	73 %	Good	38	41	6	9	9	4	8	7
Fabric 4	42	71 %	Good	38	42	9	7	7	8	3	8
Fabric 10	40	66 %	BAU	38	27	5	9	9	3	8	6
Fabric 12	40	66 %	BAU	38	29	5	9	9	3	8	6
Fabric 23	37	58 %	BAU	33	52	7	4	3	8	9	6
Fabric 22	31	42 %	BAU	24	52	6	2	2	8	8	5
Fabric 14	28	35 %	BAU	38	11	1	9	9	1	7	1
Fabric 15	28	35 %	BAU	38	11	1	9	9	1	7	1
Fabric 25	27	32 %	BAU	22	39	7	3	3	7	1	6
Fabric 24	26	30 %	BAU	22	37	7	3	3	6	1	6
Fabric 16	25	28 %	BAU	38	9	0	9	9	0	7	0
Fabric 21	20	18 %	BAU	21	32	5	3	3	4	0	5
Fabric 13	18	14 %	BAU	12	25	3	1	1	6	4	3
Fabric 1	14	9 %	BAU	22	11	3	3	3	1	1	3
Fabric 2	14	9 %	BAU	21	10	3	3	3	1	1	3
Fabric 17	13	8 %	BAU	6	40	3	1	1	2	4	2
Fabric 18	13	8 %	BAU	6	38	3	1	1	2	4	2
Fabric 19	12	7 %	BAU	6	36	2	1	1	2	4	2

[a] Out of 60 possible points

2.2.1 Scoring—metrics

To determine an overall rating based on the six impact categories, population statistics are derived for each of the metrics to determine individual scores based on percentile rankings (0th to 100th percentile). The percentile rankings are scaled to integer values from 0 to 10. For example, a 54th percentile would be a score of 5 (Fig. 2).

For each of the six impact categories, scoring is based on the following three-step process:

1. The population statistics of the expected value and the standard deviation for a representative lognormal distribution are calculated. A lognormal distribution is chosen, as uncertainties tend to be multiplicative.
2. Based on the resulting average and standard deviation, the percentile ranking for a specific impact category for the target apparel product or subassembly (e.g., fabric or sundry) is calculated.
3. The resulting percentile rankings are transformed to a 0-to-10 scale, rounded to the nearest integer value 0 to 10.

2.2.2 Scoring—final score of product or subproduct systems

The cumulative final score is based on overall scores from a possible 0 to 60 points derived from six impact categories in

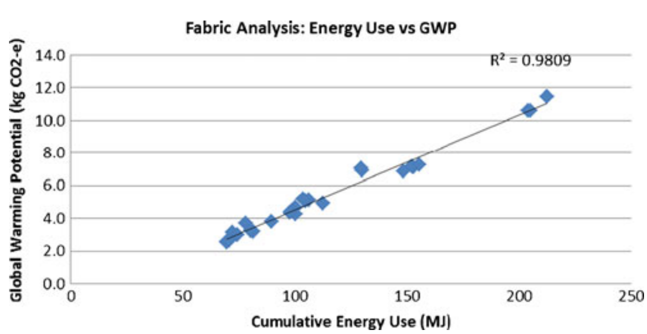

Fig. 4 Fabric analysis: energy vs. GWP

total. The six measures each have a maximum score of ten points to arrive at a total possible score of 60 points. Final scores are expressed as readily understood performance measures of good, better, and best over "business-as-usual" (BAU) practices. As shown in Fig. 3, thresholds to distinguish good, better, and best scores are based on percentile rankings of performance at 70th, 80th, and 90th percentiles, respectively. Generally, scores that rate in the 80th percentile and above are identified as examples for future design choices. Note that results above the 68th percentile are one standard deviation above the mean. The aggregate percentile rankings are based on a normal distribution due to the central limit theorem, whereby the distribution of means tends towards the normal distribution (Rice 1995).

The E-valuate scoring method is dynamic and self-calibrating, providing an incentive towards continuous improvement and the promotion of even more sustainable product solutions in the future. For example, as more environmentally preferable products are produced, a product solution scoring in the 80th percentile today scores lower in the future.

2.2.3 Weighting

For this methodology, equal weighting is applied across all metrics and indicators. It is recognized that general practice calls for normalization to occur prior to weighting; however, due to uncertainties associated with normalization factors, e.g., regional boundary incongruence with areas of protection, as well as numerical error associated with the division of small numerical quantities by large numerical quantities, normalization factors based on geopolitical boundaries are not used (Norris 2001). Instead, normalization is done by selecting reference population of products, in this case cotton denim fabric, to be used in the manufacture of men's jeans.

3 Results and discussion

3.1 Assessment of fabrics

For this pilot program, 26 men's denim fabrics were assessed using the E-valuate™ methodology. The 26 fabrics represent existing fabrics used in products currently sold. For the fabrics examined, cotton is assumed to be sourced predominately from North America, Asia Pacific, the Middle East, Europe, and Africa; however, regional differences related to cotton were only varied based on yield, water consumption, and electricity grid. Spinning, dyeing, and weaving facilities are located in similar regions of the world as fiber production.

The results for the six life cycle impact assessment metrics are shown in Table 2. The specific fabric names have not been disclosed due to confidentiality agreements with the various mills that have provided primary data. Table 2 represents the results of assessing activities associated with producing a square yard of fabric that include cotton fiber cultivation, yarn spinning, rope dyeing, and weaving. Additional metadata for this analysis includes the denim fabric weight in ounces per square yard, primary energy use (in megajoules), and total fiber loss as a percentage output to input.

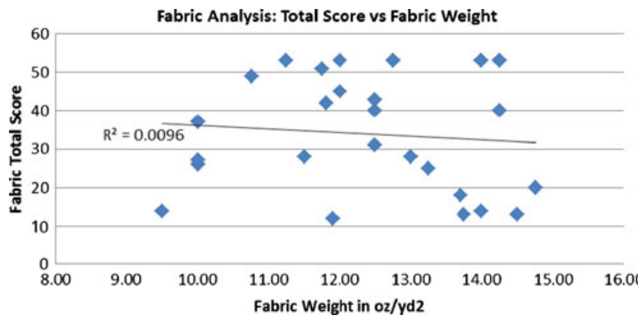

Fig. 5 Fabric analysis: fabric weight to total score

In order to better interpret the results, Table 3 summarizes the resulting rank order E-valuate™ scores. Within each row, the scores determined by the LCIA impact categories represent a relative measure of performance. For example, a score of "8" represents a result that includes the 80th percentile up to but not including the 90th percentile of performance. Similarly, a score of 5 represents performance including the 50th percentile up to but not including the 60th percentile. Therefore, each metric score represents a relative measure among a product category for a select LCIA category. This has proven to be highly valuable when communicating performance to suppliers, as performance is communicated on a relative basis among a predetermined cohort of like products without disclosing absolute measures.

In addition, the aggregate of the six individual scores is shown as a total fabric score, with its overall percentile ranking on a normal distribution scale with the corresponding relative rating of BAU, good, better, and best. Of the 26 fabrics assessed, five were found to be in the "best" category, and two were found to be in the "better" category based on aggregate results of the metrics. Based on this result, the seven fabrics are considered to be more sustainable fabrics in comparison to the remaining fabrics, and the results may be considered as support of potential marketing claims.

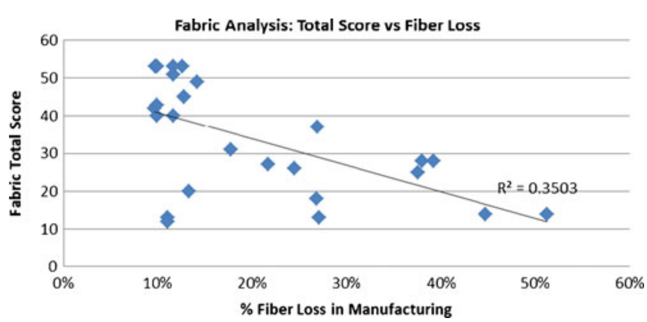

Fig. 6 Fabric analysis: fiber loss to total score

Table 4 Regression analysis across results (R^2)

	GWP	Water use	Water consumption	Eutrophication	Land occupation	Abiotic depletion	Energy use	Total fiber loss	Fabric weight
GWP		0.05	0.05	0.84	0.01	0.99	0.98	0.50	0.02
Water use	0.05		1.00	0.05	0.18	0.08	0.09	0.02	0.01
Water cons	0.05	1.00		0.05	0.18	0.08	0.08	0.02	0.01
Eutrophication	0.84	0.05	0.05		0.06	0.80	0.77	0.47	0.04
Land use	0.01	0.18	0.18	0.06		0.01	0.00	0.08	0.00
Abiotic depletion	0.99	0.08	0.08	0.80	0.01		0.99	0.50	0.02
Total fabric score	0.48	0.62	0.61	0.54	0.35	0.51	0.49	0.35	0.01
Total yarn assembly score	0.21	0.86	0.85	0.26	0.31	0.25	0.24	0.11	0.01
Total fabric assembly score	0.43	0.03	0.04	0.51	0.03	0.37	0.33	0.43	0.00

The purpose of aggregating scores and ranking fabrics is twofold: first, to determine whether a fabric is an improvement over other similar fabrics, that is, if the fabric scores within the top 80th percentile, it is to be used as an example for future product design decisions, and second, to succinctly communicate the overall relative performance of a fabric within a preselected cohort of like products (e.g., men's denim fabrics).

3.2 Discussion of results

As a result of this pilot, additional insights were observed based on the relatively large sample size for a discrete product category—denim fabrics. As one would expect, as shown in Fig. 4, global warming potential (GWP) performance is highly correlated to energy intensity (R^2=0.98, P value<<0.001). The greater the energy intensity of the materials and manufacturing activities to produce the fabric, the greater the GWP footprint.

As shown in Fig. 5 (R^2=0.0096, P value=0.63), fabric weight may or may not be a good predictor of environmental performance, despite a fairly direct relationship between fabric weight and fiber requirements. A larger sample size is required. There are other prominent factors, such as production efficiencies and energy intensities, that can vary results more substantially. Similarly, as shown in Fig. 6 (R^2=0.3503, P value=0.001), fiber loss is not a good predictor of overall environmental performance, despite a fairly direct relationship between fabric weight and fiber requirements.

When taking a broader assessment for correlation across environmental results (Tables 4 and 5), patterns emerge. Global warming potential, eutrophication, and abiotic depletion follow similar correlations to energy use. Water use and water consumption are virtually the same, as water is predominately used for cotton fiber production (contained within yarn assembly) in a dissipative manner through evapotranspiration. Total fiber loss and fabric weight are not predictors of overall score results.

At this point, no one observable factor dominates total fabric score. This may be due in part to limited primary data sets associated with cotton fiber productions (many of the same estimations on energy use and material inputs are held constant), as well as regional variability associated with grid energy production composition differences (oil, gas, coal, nuclear, hydroelectric, etc.).

Table 5 Significance test across results (P value)

	GWP	Water use	Water consumption	Eutrophication	Land occupation	Abiotic depletion	Energy use	Total fiber loss	Fabric weight
GWP		0.25	0.27	0.00	0.68	0.00	0.00	0.00	0.48
Water use	0.25		0.00	0.25	0.03	0.15	0.14	0.44	0.58
Water cons	0.27	0.00		0.27	0.03	0.17	0.16	0.46	0.59
Eutrophication	0.00	0.25	0.27		0.23	0.00	0.00	0.00	0.35
Land use	0.68	0.03	0.03	0.23		0.65	0.85	0.15	0.89
Abiotic depletion	0.00	0.15	0.17	0.00	0.65		0.00	0.00	0.50
Total fabric score	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
Total yarn assembly score	0.02	0.00	0.00	0.01	0.00	0.01	0.01	0.10	0.60
Total fabric assembly score	0.00	0.37	0.35	0.00	0.43	0.00	0.00	0.00	0.96

4 Conclusions

The E-valuate™ method is a first major step in the development of a comprehensive science-based approach to measuring the relative environmental performance of apparel products. The pilot assessment of the 26 fabrics has yielded results that can be used to inform both internal and external stakeholders. The E-valuate™ method can address the needs of three primary stakeholders: (1) relative rankings to support decisions for product designers and developers, (2) substantiation of external claims of environmental performance, and (3) communication of relative environmental performance to suppliers and contractors.

The E-valuate™ method provides an opportunity for internal design and development teams to incorporate the necessary environmental performance metrics in product design, material, and sourcing choices. E-valuate™ results can be used as an additional input for decision making, along with price, look, and supplier compliance with LS&Co.'s Terms of Engagement and Restricted Substance List programs. Inherent in the methodology is the application of population statistics to determine a moving average of performance. This provides a basis for determining a dynamic threshold for a "more sustainable" product, allowing for a continual "raising of the bar" of environmental performance over time. This dynamic approach is in alignment with current ISO standards regarding claims of a "sustainable product," as no product is truly sustainable. E-valuate™ enables a process whereby future product design and manufacturing advance along the continuum of more sustainable products.

The robust analyses can also be used to support communication to external stakeholders. Metric results from the E-valuate™ methodology are currently being used to communicate environmental performance results directly to consumers via LS&Co.'s website and additional communications channels. The E-valuate™ method also provides a means to assess and communicate relative environmental performance for suppliers. By tracking use of resources, the evaluation provides an unbiased assessment of contribution to impact and potential opportunities for improvement and catalyzing innovation in the marketplace. When suppliers are presented science-based results of environmental performance among peers, it enables them to prioritize investment in areas of improvement based on credible information.

There are significant benefits to the supplier for participating in E-valuate™. First, it encourages suppliers to meticulously document and track their resource inputs associated with product production. Documentation of this kind enables suppliers to manage inputs and identify production efficiency opportunities. Second, momentum is building in the apparel industry around the creation of a product eco-index. The E-valuate™ method is a first step for LS&Co. suppliers to prepare themselves for similar data requests and evaluations from other customers. Participating in the E-valuate™ work will allow suppliers to build the data management systems to efficiently manage requests throughout their customer base.

5 Recommendations and perspectives

In advent of the 2007 LCA studies of the Levi's® 501® jeans and Dockers® Original Khaki pants, the life cycle perspective is proliferating among the internal and external stakeholder community of LS&Co. LCA is a decision support tool and is most valuable if results are made available to those that are in a position to make decisions and when they need to be made. For product designers and developers, it is at the point of selecting fabrics, finishes, and product components that will become the basis for products in the upcoming fashion seasons. For suppliers, it is the communication of performance in a manner that is actionable. Industry average information can assist in identifying and building awareness of inherent environmental performance aspects of a particular material or process. However, when improvements have been made, especially by marketplace innovators, there is a need for more detailed information.

LCA as a general approach, the "systems perspective," is a prudent approach to quantitatively assess environmental performance and opportunities for improvement. However, there is further need for international standardization on characterizing data uncertainty and the appropriate method to select impact category indicators and scientific methods. As the application of the LCA methodology continues to proliferate in the examination of commercial product performance to determine a more sustainable product, there is a need to collectively determine the metrics and their associated level of uncertainty necessary and sufficient to support claims made.

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